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THE JOURNAL
OF
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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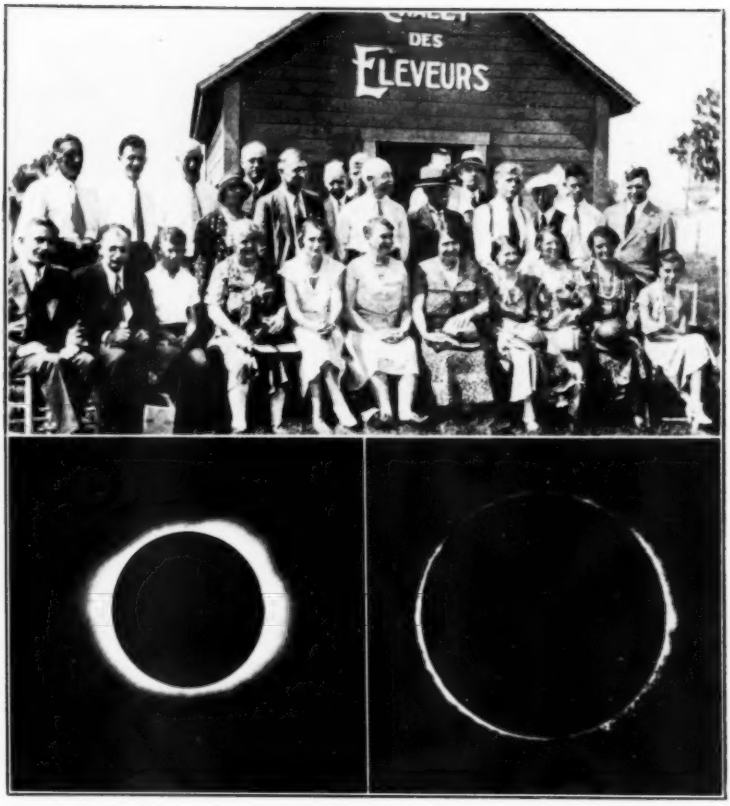
PLATE VIII



ABOVE. R.A.S.C. PARTY AT LOUISEVILLE, P.Q., AUGUST 31, 1932

Back row, from left: Kennedy, Simpson, Beatty, Mrs. Benson, Ireton, Benson, McKone, Clipsham, Barker, Patterson, Kingston Jr., Carrick, Maybee, Collins, ——, Thomson.

Front row, from left: Hepburn, Connor, ——, Mrs. Paterson, Miss Benson, Mrs. King ton, Mrs. McKone, Miss Budd, Mrs. Collins, Mrs. Connor, ——.

BELOW. *Left*: Corona by D. B. Marsh at Actonvale, 8-ft. camera, yellow filter, exposure 4 sec.

Right: Inner corona by F. H. Coates at Louiseville, yellow filter, F 3.5, exposure 1/50 sec.

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THE ROYAL ASTRONOMICAL SOCIETY

OF CANADA

Vol. XXVI, No. 10 DECEMBER, 1932 Whole No. 219

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA'S EXPEDITION TO OBSERVE THE TOTAL ECLIPSE OF THE SUN, AUGUST 31, 1932

By J. R. COLLINS

Chairman of the Committee

(With plate VIII)

BY resolution of Council in February last, it was thought desirable that the Society as such should endeavour to officially take a part in observing the total eclipse of the sun on August 31. To that end, an Eclipse Committee was appointed to make arrangements for an observing party.

The committee consisted of:—Mr. S. C. Brown, J. R. Collins, R. A. Gray, A. R. Hassard, E. J. A. Kennedy, Prof. H. R. Kingston of London, and H. L. Rogers. To this list were subsequently added the names of the president, Prof. R. K. Young; past presidents, Prof. C. A. Chant, W. E. W. Jackson, Dean A. T. DeLury, and Sir Frederick Stupart; Vice-president Mgr. C. P. Choquette of St. Hyacinthe, Quebec, and Rev. D. B. Marsh. J. R. Collins was designated chairman.

The Society being national in scope, it was desirable that as far as possible representatives of all the Centres should take a part in the endeavour. The various Centres were communicated with in regard to the proposed effort and London, Hamilton, and Vancouver responded. It was found that Hamilton Centre had already made arrangements for observing at Actonvale, Quebec. The London members heartily co-operated with us. Louiseville, P.Q.,

was selected as our observation post—latitude 46°16′, longitude 72°56′. 4½ miles east of central line of path of totality. Elevation, 40 ft.

The time given us by the Dominion Observatory, Ottawa, for Louiseville was in Greenwich civil time.

	h.	m.	s.
First contact	19	13	18
Second	20	22	34
Third	20	24	15
Fourth	21	28	27

Duration of totality, 101 seconds.

As the committee was unable to secure financial aid from either public or private sources, or to arrange for excursion rates from the railways, it was decided that we motor down to Louiseville and carry with us what instruments we could, at our own expense. Cars for the transportation of observers and equipment were volunteered by Mr. Kennedy, Mr. Brown, Mr. Collins and Mrs. Margaret Paterson, of Glendale, California. Most of the other members and friends motored down in their own cars and thus our cavalcade set forth.

An 8-inch aperture telescope camera, a panoramic camera, metronome, sheets for observing shadow bands, and a number of smaller cameras were among the equipment. These were augmented by thermometers, barometers, and charts for noting cloud formation, which were kindly supplied by the Director of the Dominion Meteorological Service. Mr. Andrew Thomson, chief physicist, also accompanied us and took charge of the meteorological observations, assisted by Mr. A. J. Connor, chief weather forecaster. A number of similar instruments were supplied by the London centre, including a photoelectric-cell photometer.

The Mayor of Louiseville, M. Martin, extended us every courtesy, and secured for the party the use of part of the local fair grounds, where was also located the French Government expedition under the direction of Count de la Baume Pluvinel.

Our programme covered photographing the eclipsed sun, noting and identifying the stars or planets that might become visible, sketching the corona, also noting and timing the shadow bands, cloud formations, change in temperature, barometric pressure,

humidity, and air disturbance. These were, in a large measure, successfully made and the records obtained are here presented by those in charge of the various observations.

Mr. R. A. Gray sketched and made a painting of the eclipsed sun and corona in colour. E. J. A. Kennedy and J. R. Collins were assigned to the telescope camera. First and second contacts were noted on the ground glass of that instrument. Baily's beads and the corona clearly appeared theron. The time agreed with that given us by Ottawa. Through an unfortunate mishap, we were unable to get the image of the corona, but were in time to catch the reappearing crescent of the sun just after Baily's beads had broken following 3rd contact. Immediately previous to this, however, Rev. Dr. C. V. Pilcher of our party secured a photograph of the corona with a small camera. This upon enlargement to 20 diameters, shows considerable detail and marks, by notches on both sides of the image, two conspicuous prominences. Mr. F. H. Coates, of the London party, succeeded in getting a larger print of the inner corona showing the prominences as well as light intensity results from a photoelectric-cell photometer.

The shadow bands were noted and timed as they danced on the white sheets provided for their reception, though only a trace of them appears in the photographs.

Photographs of cloud formations were taken by Mr. Whitehouse, including that of the approaching shadow on the clouds as it rushed over us.

The duration of totality, indicated by the metronome, counted by Miss M. E. Collins and checked by Miss I. V. Brown, was found to be in conformity with that predicted—101 seconds.

With the object of increasing the area of observation, Professor Kingston and most of the London members hastily established themselves at a point one mile and a half north of the main party in the fair grounds, and secured some interesting results as shown by subjoined reports.

The Hamilton Centre, directed by Dr. Marsh, observed successfully at Actonvale, about 40 miles south of Louiseville, securing several excellent photographs of the corona; and a remarkable series of moving pictures covering the 2nd and 3rd contacts were taken by Mr. W. G. Milne with a long focus objective.

Our 1st Vice-president, Mgr. C. P. Choquette, had his observers stationed on the college grounds at St. Hyacinthe, but intervening clouds at that point covered the sun at the critical time. Mr. A. R. Hassard with a small party stationed themselves at Verdun, a few miles east of Montreal, where conditions prevailed similar to those at St. Hyacinthe. A party from the American Amateur Astronomical Association of New York were stationed with us on the fair grounds at Louiseville, in charge of Reuben S. Lind, and observed successfully. Mr. E. H. McKone, of London, on behalf of the general society, visited about twenty of the camps and stations along the path of totality before the day of the eclipse and exchanged greetings with the observers there.

Professor Chant and Professor Young were in charge of an elaborately equipped expedition from the University of Toronto stationed at St. Alexis des Monts, about 25 miles north of Louiseville; but unfortunately clouds prevented them from making the observations for which they were so well prepared.

As the darkening shadow crept over us the cattle near us were noted to huddle together as if expectant of some impending calamity, and remained quiet during totality. After totality numerous roosters in the various poultry sheds abutting the fair grounds, surprised at the shortness of the night, welcoming the apparent dawn with unusual enthusiasm, burst forth into a veritable riot of crowing; each sent up a challenge to his foe to meet him on the ground.

The psychological effect of the entire phenomenon would be extremely difficult to describe in fitting language. The indescribable glory; the unusual tints of flashing shafts of light; of blended colour—everyone was enthralled by the unique beauty, the magnificence of the scene, and no description can do justice to it. At our best we can do none other than attempt to describe the unknown and the unusual in terms of the known and the usual.

Among those composing our party of members and friends at Louiseville were:—H. W. Barker, Prof. S. Beatty, Mr. and Mrs. T. C. Benson and Miss Benson, Mr. and Mrs. S. C. Brown and Miss Brown, Miss E. M. Budd, A. W. Carrick and Miss Carrick, Mr. and Mrs. F. H. Coates, Mr. and Mrs. J .R. Collins and Miss M. E. Collins, Mr. and Mrs. A. J. Connor, our Gen.-Sec. Mr. R. A. Gray, Mr. and Mrs. D. Hepburn, Prof. and Mrs. H. R. Kingston, Mr.

Kingston (son), Mr. and Mrs. E. H. McKone, Mr. and Mrs. J. E. Maybee, Mrs. Margaret Paterson, Prof. W. J. Patterson, Prof. H. J. C. Ireton, Rev. Dr. C. V. Pilcher, Andrew Thomson, F. L. Troyer, Henry Westoby, Rev. A. W. and Mrs. Craw, Miss Dorothy Craw, and J. Whitehouse.

Reports by various members follow.

TORONTO CENTRE PARTY

R. A. GRAY, of Toronto

There is little to report about the colours of the corona. I had prepared a board with a circle blackened to represent the moon covering the sun. I drew a number of concentric circles increasing by the radius of the moon's disk. The corona I watched very carefully and with the colours already prepared I rapidly painted what I saw. The corona was quite red for at least half its width, as if great flames were bursting from the sun, while the outer part of the corona, about half its width, shaded off to a deep purple colour.

I did not follow the streamers that some observers noticed extending for several diameters of the disk. The width of the corona at the narrowest part was about the radius of the moon, but extended at three places to nearly the diameter of the moon. I saw a bright spot near the edge of the moon, as if the sun found little crevices on the moon's surface to shine through. These may have been Baily's beads. I saw the diamond ring effect but it came all too soon and it interrupted the sketching. The time of totality was too brief to do what I had planned, though beforehand I had mixed the colours that I had reason to believe might be expected.

S. BEATTY, of Toronto.

I noticed on the white sheets spread on the ground, the shadow bands. They began with 2nd contact and lasted for 30 seconds. At first to me they seemed to be about 15 inches apart, and each one seemed to be about 2 inches wide. The bands had no proper motion but appeared to be dancing or oscillating, so that it was hard to be sure of their location.

They seemed to run about 10° north of east. The bands were visible for about 15 seconds at 3rd contact too, and behaved in roughly the same manner.

I think 30 seconds is a fairly accurate reading for Mr. Ireton was there with me and we counted till we could see the bands no more.

If the bands are diffraction fringes, that would mean that they can be seen just faintly, out 30 miles on the earth from the straight path of light. The dancing looked like unevenness due to air jumping up and down.

J. WHITEHOUSE, of Toronto

The work assigned to me was to photograph cloud formations and to attempt to photograph the shadow bands as well. The latter was, of course, new to me

and I did not have much information to guide me. It was assumed their velocity would be about 15 miles per hour but those I saw appeared to move many times faster than that. The bands did not appear to be sharply defined. They at times almost blended into one another and overlapped, giving to-and-fro motion nearly parallel to the motion of the moon across the sun's surface.

These dancing waves were the most elusive things imaginable to observe and to try to photograph. The white sheet on the ground was marked with direction lines for guidance. I may say that these sheets which shortly before were perfectly dry, were, after the eclipse, quite damp and heavy with moisture.

I had my camera on a tripod, focussed on the sheet, with the shutter set for 1/15-second exposure, using a 3.9 Dallmeyer lens with focal plane shutter and panchromat filter.

The speed to me seemed surprisingly great and the contrast of these flickering waves to their background was extremely faint. The dark lines appeared to me at times as little as ½ inch in width with spaces between about 6 inches as they hesitatingly moved across the sheet. An extremely fast lens with focal plane shutter and exposure of not less than 1/100-second would appear to be absolutely necessary for this work. With the clouds the difficulty is not so great, and some excellent views were secured. The information we have gained may be of value for future efforts. I enjoyed the experience immensely. To me as well as the others the sight of the eclipse was the thrill of a lifetime.

H. W. Barker, of Toronto

A partial eclipse of the sun excites great wonder and admiration, but this is nothing in comparison with the thrill one gets when the sun is completely blotted out and in its place for a few moments appear the beautiful Baily's beads, the glorious corona, the flaming prominences and the other features which are reserved only for totality. A total eclipse of the sun is the most impressive spectacle the heavens can display.

(For the rest of Mr. Barker's report see the November Journal, p. 422).

LONDON CENTRE PARTY

H. R. Kingston, of London

About forty people from London, members of the London Centre and their friends, were gathered at Louiseville, P.Q. During the early forenoon, the sky was very clear but by noon some clouds began to appear. At the time of first contact the entire horizon and the north and the east skies were covered with clouds, while in the south-west the sun shone in a beautifully clear sky, except for one or two cumulus clouds. About twenty minutes after first contact, a dark cloud drifted over the sun and entirely obscured it until two or three minutes before totality. Our party was in a field about a mile north-west of Louiseville, and while the sun was hidden by the clouds, we could see the brilliant sunshine over the town and along highway No. 2 less than a mile distant, where the main party was located. White sheets had been placed on the ground and an attempt was to be made to place laths on the sheets to indicate the direction and distance

apart of the shadow bands, both at the beginning and at the end of totality. Also, several cameras were ready for photographing these elusive shadows, if possible. However, no bands appeared.

About eight minutes before totality, when it seemed very probable that the cloud would not pass away from the sun before totality, I suggested that all who were free should jump into their cars and go over to the highway. In a couple of minutes, all but five of our party were gone, and they were rewarded with a perfect view of totality. Several of them saw the shadow bands very clearly on the road and the sides of buildings and on the white dresses. A number made sketches of the corona, and Mr. S. J. Versteeg, an artist member of the London Centre, painted a picture of the corona and also a picture of the shadow bands as they appeared to him. He said the latter appeared to flicker back and forth, rather than to move forward. The five of us who remained, saw the crescent appear through the fleecy edge of the cloud two minutes before totality, and watched it rapidly narrow down and finally disappear with a great flash of light. The coronal light was visible close around the edge of the sun. The darkness was not nearly as intense as we had expected, even after making allowance for reflection from the distant clouds. A drop in temperature was very noticeable. The sheep nearby all stopped grazing and started for a corner of the field.

The scientific equipment of our party consisted of photoelectric instruments, which were operated by Mr. F. H. Coates. His report follows.

F. H. Coates, of London

With a suitable instrument, equipped with a photoelectric cell, it is possible to record very minute changes of light intensity, which would not be discerned with the human eye. An instrument of this type, used during an eclipse, produces an accurate graphic record of the light intensity.

Two instruments of the photoelectric type were used during the eclipse, a self-recording microphotometer and a photoelectric cell and meter used for visual records. An automobile was used as a portable laboratory containing the recording mechanisms. These consisted of a motor for rotating the drums of photographic paper, a timing device and the galvanometers. The car was covered with a large tarpaulin to exclude light from outside, and a cable connected with the galvanometers was brought out to the running-board of the car, where the photoelectric cell and the microphotometer were placed.

One of the galvanometers had a sensitivity of 0.003 microamperes, the other a sensitivity of 0.0003 microamperes, and both were equipped with an external critical damping resistance to overcome the inertia of the suspension. By using two types of galvanometer, it is possible to secure a general record of light changes and also a record of the very delicate changes during totality.

While clouds obscured the sun during the greater part of the eclipse, thus preventing visual observation or photographic recording of the actual phenomenon, the photoelectric photometer was not quite so seriously affected, owing to the fact that the clouds acted merely as a filter, reducing the actual intensity of light and causing fluctuations of the photoelectric current, yet giving the general

reduction of luminosity as the eclipse progressed. During totality, only a faint haze masked the eclipse, making it possible to record fairly satisfactorily the light values at that period.

At 2.08 E.S.T. the photometers were standardized by the visual instrument containing a microammeter of 0-500 range. Fortunately, at this time an opening in the clouds revealed the sun against the blue sky. At this moment the dia-

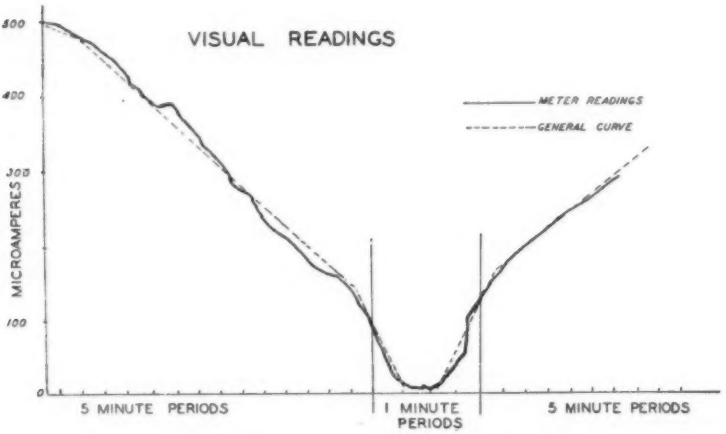


FIG. 1. Curve plotted from the visual photometer.

phram covering the photoelectric cell was adjusted so as to make the needle of the meter read maximum, or 500 microamperes. At 2.14 first contact was visible and the visual readings were commenced and continued every 5 minutes. Simultaneously the motor of the self-recording photometer was started. Very little change in the reading was noted from first contact until 2.24, when the needle dropped to a reading of 496 microamperes. Clouds were approaching from the south-west, gradually obliterating the sun, and at this time the drop in the reading was considerable—from 496 to 190 microamperes. As the clouds moved gradually across the sun, the intermittent light and shade of the cloud forms influenced the meter reading. However, the general current drop steadily continued, as is apparent if the main points of the current be plotted and connected. The resulting curve gives us a general idea of the drop in luminosity. Fig. 1 shows the curve plotted from the visual photometer. Fig. 2 illustrates the record made on the self-recording photometer; owing to the extreme length of the photographic record it is possible to show only the portion taken during totality. The remainder of the record, however, compares favourably with the readings of the visible photo-

meter. During totality only a faint haze covered the sun, giving an almost unblemished record. The small peak midway on the record is unaccountable, but may be due to coronal changes creating additional light not noticeable to the eye but capable of increasing the photoelectric current.

Between the intervals of making readings, photographs were taken illustrating the disappointing conditions of the sky. The effect at totality (see Pl. VIII) was

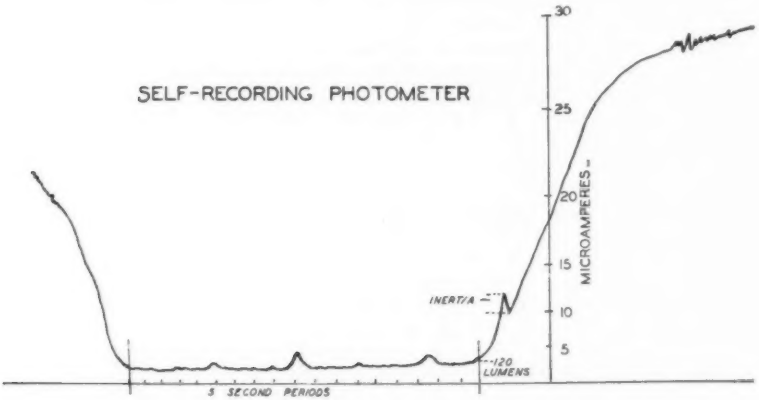


FIG. 2. Record made by the self-recording photometer.

taken with a Leica camera equipped with an 150 cm. telephoto lens and a Wratten H filter.

A series of pictures was also taken looking towards the west as the peculiar coloured lighting effects gradually came towards us. These, however, show little of value in monochrome—only an autochrome plate could record the spectacular changes in colour. All of the above photographs were taken with an exposure of one-fiftieth of a second with an F 1.9 lens stopped down to F 3.5.

HAMILTON CENTRE PARTY

W. S. MALLORY, of Hamilton

The main party set out by auto from Hamilton early Friday morning, August 26, 1932. It was made up of Dr. D. B. Marsh, scientific head of the party, his wife and his son, John A. Marsh; George E. Campbell, Secretary-Treasurer; Prof. Wm. Findlay, Ph.D., of McMaster University and his son, John Findlay; T. H. Wingham, B.A.Sc., and W. S. Mallory, M.A., President of the local centre. The equipment, both scientific and camping, had been sent on ahead by truck.

By Saturday noon the entire party just described had arrived at Actonvale

and after a very kind reception by the Chamber of Commerce, we started to pitch camp and get our telescope stand oriented and made solid. Rain and clouds made it very difficult to accomplish this readily, but by Monday evening we were satisfied that the instruments were on meridian, but knew our declination was about 4 minutes out.

The site was an excellent one, being on an elevated ridge running north and south. A fine view was to be had in all directions for miles. To the west and northwest the land sloped away for miles and afforded us an excellent opportunity to observe the approach of the shadow.

Our party was augmented by the Rev. E. Doe, of Woodville, Ont., and his son, Earlston Doe; G. H. Mallory, of Toronto; LaVerne White, who hitch-hiked from Hamilton, and is a schoolboy much interested in astronomy. Mr. Simpson, once Secretary of the Dominion Observatory, also joined. On the day of the eclipse, W. G. Milne and H. Muelman arrived.

Three refracting telescopes were mounted on a clock-driven standard. These were equipped so as to photograph totality with foci equivalent to 22½ ft., 14¼ ft., and 10 ft. The larger camera used a 5x7-in. plate and the other two 4x5-in. plates. One telescope had an orange filter, one a yellow, and one a specially prepared blue filter. Two other 3-in. refracting telescopes were used for observational work. Besides these, sensitive magnetic needles on both horizontal and vertical axes were used, a hygrometer, an altitudometer, thermometers, baromters, chronometers, a metronome and equipment to study shadow bands.

The morning of the eclipse was most uncertain. At one time the sun was shining intensely and at another was hidden behind threatening clouds.

When first contact occurred the sun was obscured by clouds. Occasionally the clouds broke sufficiently that we could get glimpses of the progress of the moon across its face. The sky in the neighbourhood of the sun was not clear until 3.11. At 3.16 everyone was in place and all was getting weird. At six minutes to go, the policeman called in French, "Silence!" to the crowd assembled outside our enclosure. His warning was not needed because the spectacle itself had silenced everyone. At 3.20 a decided wind blew from the west, its velocity being estimated at 5 m.p.h. At 3.21.30 the corona could faintly be seen. At 3.22 Venus became distinctly visible to the north-east. An observer trained a 3-in refracting telescope on it and it was seen a crescent. Just before totality Baily's beads were seen.

During totality, 4 exposures were made by each telescope camera. One of 2 and the others of 4, 6 and 8 seconds. (See Pl. VIII). Twelve successful photographs were made. To the naked eye, the corona extended to the left and up about one and a half diameters of the moon as a spearhead and to the right and down for nearly the same distance but as a broader band, being deeply notched about the centre. These were joined by narrower bands around the moon. Several sun flares, as narrow streamers, were noticed which show in the photographs. Venus was visible, also Mercury. Some say this was Jupiter. However, Jupiter should have shown almost in the corona. One observer saw it oval in shape. Arcturus was also seen. On the day preceding the eclipse we used the telescopes to locate the positions of Venus, Mercury, Jupiter and Regulus. To do this, of course, we made use of the circles and ephemeris. In this way we charted these

stars with reference to the sun at the time of totality. Thus we feel certain our naming of the planets is correct. Possibly clouds prevented some of the brighter fixed stars from being seen. The sky was a purplish colour. It was not as dark as many expected, probably because the clouds reflected light into the umbra.

The altitude of the sun at the moment of totality was 28°10′. Duration of the totality according to our count was 90 seconds. Two chronometers agree and the count by the metronome was 89 which, of course, was one second late. [Other observers report the duration of totality approximately 100 sec.—Editor]. Totality started a full second later than was timed for Actonvale. The temperature dropped from first to third contact 9 Fahrenheit degrees. About 4 or 5 degrees could probably be accounted for by clouded condition. Barometers showed no change. There was no magnetic disturbance. The humidity rose as is usual. The table below shows its readings:

12.00 noon	70%
1.00 p.m.	76.5
2.00 "	70
3.00 "	83
3.15 "	86.5
3.18 "	87
3.20 "	88
3.21 "	88.5
20 seconds after totality	90

Shadow-bands were studied by two observers. Before totality bars about ½ inch wide and 5 inches apart, running parallel to each other, moved almost due north from the south. This continued for about 11 seconds before totality.

After totality, bands very similar to the first, but less distinct, moved to northwest by north. These lasted about 8 seconds. Their estimated velocity was 5 ft. per sec. Another very spectacular photograph was made by a moving picture camera equipped with a 2-in. refracting telescope. The difficulty of operating this by hand so as to follow the sun and time the partial phases and totality anywhere near correctly cannot be easily described but it was accomplished successfully. No colour filter was used so the corona appears more like what was seen by the naked eye. Wherever shown, these pictures have provided a thrill.

The telescopic photographs have proved to be of great worth since it would appear that our centre was the only Canadian location where totality was photographed by cameras of long focal length. It is believed that these photographs may reveal something of real value, especially those made by the blue filter.

Each member of the party was assigned a definite task and each did his part without a fault. The writer has intentionally omitted to name the parts played by individual members and presented their combined findings in this report.

A. F. MILLER, of Toronto

My extremely defective eyesight rendered it impossible for me to observe satisfactorily this eclipse. However, my daughter, Miss Gabrielle Miller, using a non-achromatic solar projector (see this JOURNAL, v. 15, p. 248), which gives a disc about 7 inches in diameter, and a watch showing standard time, made the

following observations:—

First contact at 2.12.
Greatest obscuration here, 3.24.
Last contact at 4.32.

We were both much interested in noting the wonderful accuracy of the predictions announced.

Owing to my inability to adjust the focus quite sharply, we were unable to say whether any sun-spots existed at the time we were observing.

Miss Miller was much struck by the phenomenon of the crescent-shaped silhouettes or projections of the eclipse by solar rays, traversing the foliage of trees and falling on adjacent objects. Her attention had not previously been directed to this interesting effect.

Shortly after the time of greatest darkness, our household cat, which had been wandering, returned home, evidently believing that night was approaching. Weather conditions for observation were very favourable, though the day was extremely warm. There was a perceptible fall in temperature as the eclipse progressed. The sky had a somewhat lurid aspect, very different from the twilight effect. We attribute this to the depth of penumbral shade and the proximity of the great lunar umbra, cutting off sunlight from the upper atmosphere.

STUART L. O'BYRNE, of Webster Groves, Miss.

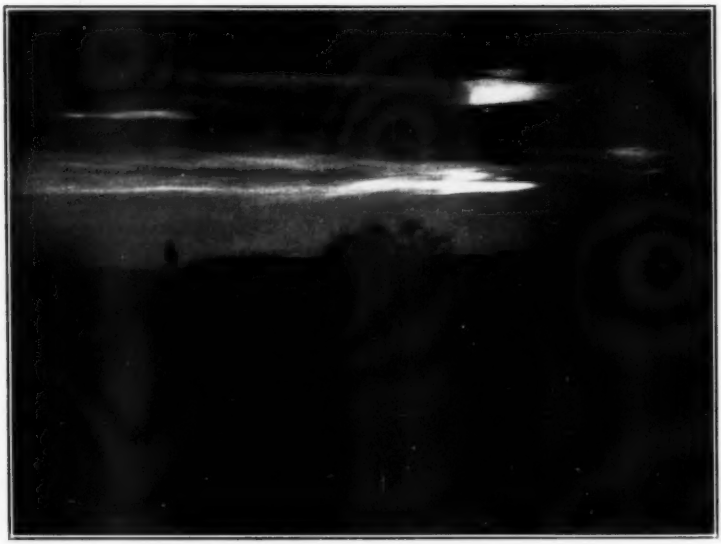
Temperature readings made during a partial solar eclipse are not without interest as they can be compared with those made where the eclipse was total. At my observing station in Webster Groves, Missouri, temperature readings were made at frequent intervals during the partial eclipse. The thermometer was placed so as to receive a free circulation of the air and was shielded from the direct rays of the sun. The eclipse began at 1.11 p.m. (Central standard time) and ended at 3.33 p.m., with the maximum phase of 0.71 coming at 2.25 p.m. At the beginning the sun was behind a heavy cloud, but by 1.19 p.m. the cloud was thin enough to enable the sun's disc to be seen; by 1.23 p.m. the clouds were entirely gone from the region of the sun, which remained clear until the end. The results of the observations are given in the following table:

C.S.T.	Temp.	C.S.T.	Temp.
1.10 p.m.	90°F.	2.25 p.m.	89°F.
1.19 "	91	2.30 "	89*
1.30 "	93	2.40 "	89*
1.40 "	94	2.50 "	90
1.50 "	93	3.00 "	92
2.00 "	91	3.10 "	93
2.10 "	90	3.30 "	94
2.20 "	89		

Note: *Temperature slightly below 89°F.

The data show that the drop in temperature was a little more than 5° and that the minimum temperature was reached between 2.30 and 4.30 p.m., about 10 minutes after the maximum phase of the eclipse, as should be expected.

PLATE IX



MOTHER OF PEARL CLOUDS

Taken before sunset, January 13, 1932, at Oslo, Norway, facing WSW.
(Photograph by C. Störmer.)

PLATE X

MOTHER OF PEARL CLOUDS

Taken before sunset, January 13, 1932, at Oslo, Norway, facing other directions than WSW.

(Photographs by C. Störmer.)

MOTHER OF PEARL CLOUDS*

By Andrew Thomson

(With plates IX, X)

MOTHER of pearl clouds are a beautiful and puzzling sky phenomena which were first reported by the late Prof. Mohn[1] in 1893. At rare intervals from 1871 to 1892 he had seen these brilliantly coloured clouds in the vicinity of Oslo, Norway, and from rough methods determined their height to be from 23 km. to 140 km. No more observations of these clouds were published until 1927, when Prof. C. Störmer[2] gave an account in German of his observations of mother of pearl clouds visible at Oslo, on December 30, 1926. A translation of part of this account is as follows:—"It is surprising to see once more these iridescent clouds. They remain unforgettable in my memory from my school days, when at the beginning of the nineties I had the luck to observe these beautiful clouds. Ever since then I have searched the skies to get another view of them, but this winter for the first time I have seen them again.

"I took the first cloud photographs at 15 h. 17 m. on Dec. 30 (Middle European time). The clouds appeared in the southwest above the sun in beautiful rainbow colours. Their characteristic rhombic form was less predominating than in the nineties. Photographs were made with red, yellow, green and violet filters on panchromatic plates and best contrasts were obtained with the red filter.

"Some time after sunset (15 h. 16 m.) the clouds became more and more brilliant and later took on a strong red coloration which died away at 16 h. 19 m. The clouds still remained visible, of a weak blue-gray colour, but brighter than the sky background. I followed them attentively until stars of the first and second magnitude were visible."

The heights of these clouds, determined by photographing them

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simultaneously from two stations by the method employed in determining the height of the aurora, varied from 26 km. to 30 km.

Mother of pearl clouds were again seen by Prof. Störmer[3] at Oslo on Jan. 13th, 1929, which were briefly reported in "Nature" for Feb. 16th, 1929, and in great detail in a memoir now published entitled "Höhe und Farbenverteilung der Perlmutterwolken".[4] A translation of some paragraphs is as follows:—"On January 13, 1929, I saw the mother of pearl clouds first in the southeast sky before sunrise. The contours of the clouds were not so sharp as later on at sunset, but the coloration displayed the typical pure beautiful spectral colours of these clouds.

"In the afternoon the clouds appeared again and I telephoned to my auroral stations at Oslo and Oscarsborg, 27.36 km. distant, to be ready to take simultaneous photographs after sunset to determine their height.

"According to another observer at Oslo, large iridescent clouds lay all that day over Oslo. The form was similar to the uniform wavy alto-cumulus and the colours were gray and blue-gray in a series of places transforming into faint red, violet and green." About sunset quite another type of iridescent clouds formed. These newly apparent clouds glowed strongly with sharp contours in a series of colours from red and violet to yellow, green and blue. Both observers agreed that directly after sunset the clouds glowed intensely in all the colours of the rainbow. A series of 92 plates were obtained, of which 38 were useful for height determination, the only difficulty being that the sky was so bright that the stars could not be photographed and the mountains in the background had to be used for reference points.

Prof. Störmer's sketches and photographs of mother of pearl clouds exhibit a brilliant display of spectral colours arranged somewhat similar to the coloration of the nacreous layers inside a clam shell. The colours of the clouds are exceedingly pure and striking, including rose, lilac, green, blue-violet with red tints predominating. The colours are not fringes around the edges, but extend in band after band into the centre of the cloud. During the daytime it is more difficult to distinguish mother of pearl clouds because the colours are not so prominent. The clouds, however, may be followed

by their thin bluish white background, against which the colours may be often seen faintly shining. The bands of spectral hues differentiate mother of pearl from iridescent clouds. The latter are not infrequently observed in temperate latitudes, within 30° of the sun and are ascribed to super-cooled water droplets at an altitude of 8 km. to 10 km. The only other form of stratosphere cloud is the bluish-white noctilucent cloud, probably at a height of 80 km., which was generally associated with volcanic eruptions. This year, however, a large number of people observed noctilucent clouds in southern Norway on July 10-14 and July 24-25, which were not connected with volcanic outbreaks except it be the small eruption in Chile on April 10th. Prof. Störmer has been able by photographs taken simultaneously at two stations to determine that the height of these noctilucent clouds lay between 43-55 miles (70-90 km.), and that they were moving towards SSW, with a velocity of 90-110 miles per hour (40-50 metres per second).

Mother of pearl clouds have commonly either a lenticular, rhomboidal or ribbon-like form, and at first glance might be taken to be of alto-cumulus origin.

Wide publicity has been given mother of pearl clouds in Norway, and their appearance in parts of that country would seem to be definitely confirmed[5] on the following dates in 1932:—Jan. 14, 27, 28, 29, 30; Feb. 1, 19, and 20. The only reported observations made outside of Norway has been by Prof. Irvine Masson while travelling on a train on Jan. 18, 1932, in the south of Scotland. Prof. Masson's description, in part, is as follows:—

"The time would therefore be, say, 3.30-4 p.m. The sun had sunk behind a westerly bank of clouds, but there was plenty of daylight in the sky. There were two patches of vividly iridescent clouds; we watched the play of colours for about a quarter of an hour. It need only be added that the clouds that were iridescent were obviously very high and what an uninstructed person would call cirrus. The iridescence was about as light as that of a fairly good rainbow and the red and green were naturally predominant."

Nature of Mother of Pearl Clouds

All height determinations lead to the result that mother of pearl

clouds occur between the altitudes of 22 km. and 30 km.—a region of the atmosphere where prior to their discovery no clouds were believed to exist at this level. At 25 km. altitude the atmospheric pressure is approximately 20 mm. and the matter in 1 cu. metre weighs about 40 grams. The highest cirrus cloud ever measured in the latitude of Oslo was 11.34 km. The average height of the troposphere over Oslo above which convection movements in the atmosphere are very slight, occurs at 10 km. The temperature of the air, from consideration of the velocity of the sound of explosions, is believed to increase very rapidly at levels of the mother of pearl clouds. As the best approximate value, we take the mean of Duckert and Gutenberg's winter values of the temperature at 25 km. as minus 48°C. and at 30 km. as plus 27°C. This temperature discontinuity may be associated with changes in other properties which are entirely unknown at the present time. The only clue to their composition is from an observation of Prof. Störmer's of the corona formed by the moon's rays after passing through a rather homogeneous mother of pearl cloud. This consisted of a bluish-yellow inner region bounded by a red ring with an inner diameter of 14° to 15°. The outer radius was not measured, but if it is assumed to be 18°, the computed diameter of the cloud particles does not exceed 0.0025 mm.

The horizontal velocity of the mother of pearl clouds was 75 metres per second (170 miles per hour) on Dec. 30, 1926, but on Jan. 13, 1929, the velocity was too small to measure—1 metre per second. The vertical movement also varies widely. During a period of 79 minutes on Jan. 13, 1929, when height determinations were made at frequent intervals, the mother of pearl clouds fell steadily a distance of 1.5 km. or 0.3 m. per sec., but another series for 21 minutes on the same day showed a constant height of 23.8 km.

Times Favourable for Observing Mother of Pearl Clouds

These clouds have been observed only after the passage of a wave of low atmospheric pressure. On such occasions over a level region the sky is generally covered with thick cloud which would effectively prevent seeing clouds at great altitudes. Oslo lies a short

distance east of the Dovrefjeld range and the warm air temperatures produced by the föhn winds in the lee of these mountains dissolves the low clouds.

Observations in Canada

Observers in northern Alberta are in the same latitude as Oslo and similarly situated in the lee of a mountain chain. After the passage of a low pressure centre and during a Chinook, observers might look for these brilliantly coloured clouds. Mother of pearl clouds may occur all the year round and noctilucent clouds during June-August. The observations should include the length of time the clouds were seen, direction and velocity of movement, with sketches of cloud form and arrangement of colours.

Amateur astronomers with photographic equipment have special opportunities to investigate these high clouds. If a telephone line is at the disposal of two observers, photographs to determine the altitude and motion of these clouds can be taken simultaneously with a base line of 10-20 miles. A small aperture should be used for photographs, taken about sunset, but a full opening after sunset when stars of the first or second magnitude are visible. The position of the cameras should be fixed and prominent points on the landscape common to both observers included if possible in the landscape. Afterwards these points can be measured with a theodolite and calculations of cloud height made by measuring corresponding points in the clouds relative to the landscape.

The author of this article is indebted to Prof. C. Störmer for many suggestions and for permission to print hitherto unpublished data regarding his most recent work on noctilucent clouds.

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HOW THE EARTH WAS FORMED*

By R. K. Young

THE manner in which the earth originated must be considered as a part of the larger problem, the formation of the solar system and indeed the formation of the stars themselves. You may ask, why the necessity for any theory of formation of these bodies? Have they always existed?

Observation with the telescope shows that the solar system consists of nine planets besides the central sun and all these planets revolve around the sun in the *same* direction. All execute their orbits in nearly the same plane. All have nearly circular orbits. The system of Jupiter and its nine moons is also built on similar lines and Saturn too is much like Jupiter. These facts point to a definite system in the formation. Moreover we see in the far distant spaces of the universe, conditions which strongly suggest the formation of sun's themselves so that we are forced to conclude that an evolution has been going on which results in the birth of suns and planets.

We next ask ourselves, where shall we start the history of the earth? What shall we assume as a beginning? One thing that we can be sure of, is, that the law or gravitation, that all matter tends to attract matter, acted in the beginning as it does now. At the present time the law of gravitation holds with great exactness both near the sun and to the most remote depths of space that we can penetrate. It is the best established of all natural laws and we can be as sure of its truth as we are that the sun will rise to-morrow morning and far more sure of it than that we know our own name. In consequence of the law of gravitation, the general tendency of matter is, to gather together. It seems reasonable, therefore, to take as a beginning, a time where all matter in the universe was in a finely divided state and uniformly scattered throughout space in the form of a gas.

We would like to be able to go still farther back and be able to say, how the matter itself came into being but this is a mystery to

*Broadcast from Station CFRB in the University of Toronto series of broadcasts, spring term, 1932.

which we have no answer and perforce we must be content to hypothecate that the matter was there. When we assume that it was of the nature of a gas we tacitly assume that the individual particles were in motion. This is necessary because otherwise it would immediately draw together—into a central condensation under the law of gravitation. The assumption of motion is equivalent to saying that the gas had a temperature different from absolute zero because heat is nothing more or less than the motion of the molecules which compose a body.

We can compute approximately what the density of the primordial gas must have been because from observation we know the masses of the stars and about how thickly they are scattered in space. Our starting point is then, a time when all the matter was uniformly distributed in the form of a gas through a volume of indefinite extent and we know the density of the gas and that its temperature was not zero.

It can be shown that such a large volume of gas is unstable, that is, that it will not continue as such; and the course of evolution is for it to divide into smaller masses with void spaces in between. How large these condensations are, how much matter would hang together in one condensation depends on the density and temperature. Under the known conditions the amount in one condensation turns out to be sufficient to form not only the earth, the planets, the whole solar system, but even enough to form all the stars we can see about us even in the most powerful telescopes. The name given to these condensations in the primordial nebula is island universes. We can think of ourselves then after the first step in evolution as belonging to one of these accumulations.

The conditions in the accumulation would be somewhat different from that in the parent nebula. The density would be greater, the temperature higher and, still more important, the whole body would have a rotation about a chance axis because in the act of separating from the original nebula the individual motions of the molecules would not necessarily cancel so as to leave zero rotation.

This rotation is very important for the course of evolution because we have now two opposing factors,—gravitation, which tends to pull together and rotation which, owing to centrifugal action, tends

to throw apart. These two factors set up a stability at least temporarily so that condensations would not form within the island universe. The evolution that such a mass of gas would take has been very well worked out. There would be general contraction under the law of gravitation, an increase in density, an increase in temperature and a speeding up in the rate of rotation and this will continue for long ages until another condition of instability is reached when the centrifugal action becomes so great that gravitation will not hold the mass together. This lack of power on the part of gravitation will first manifest itself along the equator where the velocity is greatest and matter is ejected in this plane. This matter takes the form of two long spiral arms which wind themselves about the central mass. We see in the sky thousands of these objects and call them spiral nebula. They are island universes which have reached this stage in their evolution.

The matter composing the spiral arms is somewhat in the same condition as it was in the original parent nebula, that is, its grandparent, save that the density will be higher. It is again in a condition where condensations can form. It is significant that observation in the telescope shows a great many condensations in the spiral arms but none in the central part of the spiral nebula. Owing to the increased density the amount of material forming in one condensation is now smaller. The size of the condensation varies inversely as the density. Computation shows that the condensation will be of about the right order of magnitude to form individual suns. We think our sun has been so formed and exists as one condensation among hosts of others in one arm of a spiral nebula.

If we imagine this process repeated on the sun and matter being thrown off from it as it condensed we could have the birth of the solar system. There are insurmountable difficulties in such an hypothesis because the rotation of the sun is not rapid nor does it appear that it ever could have been nearly rapid enough to become unstable. Moreover, had the matter from which the planets have been formed been thrown off from the sun in this way, they would have been ejected from the solar equator where the force is greatest. Consequently their planes of rotation would have agreed with the solar rotation, but the axis of the sun is actually inclined at several

degrees. At the same time we cannot suppose that the solar system represents descrete condensations in the arms of the original nebula because the disparity in the masses of the planets and that of the sun is too great and such an hypothesis would fail to account for the uniformity in the direction of rotation. Astronomers are agreed that an outside agency must have caused the sun to eject the material which formed the planets.

At the present time the sun and solar system is almost entirely free from outside action. The nearest star, proxima Centauri, is over 20 million million miles away. But our sun is moving through space with a velocity of more than 12 miles per second and in the course of the long ages during which all the changes which I have been describing were taking place, a time which is measured in millions of millions of years, it may and probably has in some stages of its existence come much closer to some other star.

The effect of the approach of our sun to another star would be the production of tides in the solar surface, and the closer the approach the greater would be the disturbance. Those who have examined the problem critically tell us that if the wandering star approached within a few solar radii, without actually striking the sun, the tides would take the form of two spiral arms stretching out from the sun's equator and that the material composing these arms would not subside after the passage of the star but would condense around centres within themselves and form the planets.

Not all the matter so ejected would condense into the planets and at first these bodies would be moving about the sun in one plane in highly eccentric orbits and presumably amid considerable debris caused by the catastrophe. It is thought that the tidal action of the sun could have acted at that time to form the satellite systems of the planets much in the same way that the planets were formed from the sun by the passing star. At the same time the resisting medium formed of the debris through which the planets moved would cause their orbits to become more and more nearly circular.

To recapitulate then, we have the parent nebula. We go from parent nebula to island universe, from island universe to spiral nebula, from the arms of the spiral to the sun and from the sun, by a chance encounter with another sun, to the planets of which the earth

is one. I hope you will not consider these statements as wild speculation nor accpet them as absolute facts, but rather that they will make you ask yourselves the question, I wonder—I wonder if it is true? And I hope to stimulate some of you to ascertain the facts about the universe and so come to a better appreciation of the things that must be accounted for in any rational theory as to the origin of our world.

Note.—Fuller information on this subject is available in the *Encyclopedia Britannica.*

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

Curvature of Space

If one considers the circle as a conic section whose eccentricity e is 0, or as a conic the foci of which are coincident, then if we take one of the two foci, say the lower, and slip it out from beneath the upper, we get an ellipse whose e is less than 1. Let us move this one continuously to the left so that e will continue to get larger until, when the focus which originally started out in coincidence with its mate is at an infinite distance from it, e is equal to 1, and the ellipse becomes a parabola. If now we continue to push the focus farther and farther to the left e is greater than 1, and the parabola becomes an hyperbola, and the focus which was moved continuously to the left now appears at the *right*. If space is not curved how did it get there? The one stumbling block in the above which has occurred to the writer is how we can add something to infinity, which apparently has to be done to make the moving focus come up at the right.—T. R. SCHULER, Maywood, Ill.

ANSWER

I think the answer to the above query is that this behaviour of the focus has nothing to do with the curvature of space. We are dealing here with a plane surface in Euclidian geometry, and the phenomenon described is a property of infinity in that geometry.—C.A.C.

VENUS AND JUPITER IN DAYTIME.

Mr. R. H. Spurway, of Nelson, B.C., writes:—The mornings of the 18th and 19th of October were quite clear and I made observations of Venus and Jupiter between 11 and 11.30 a.m. in bright sunshine. The planets were in the same field of view in my binoculars and on the 19th they were quite close together.

A NEW ASTRONOMICAL PUBLICATION.

The first issue of a new monthly publication, named *The Astronomical Digest,* and described as "an abstract journal and index of astronomical publications for the professional and the amateur", has just appeared. Robert Barnes Butler, of 963 Kenyon Ave., Plainfield, N.J., is editor and publisher, and Marshall C.

Harrington, of Drew University, Madison, N.J., is associate editor. The subscription price is, Domestic, $2.50; Canadian, $2.75; Foreign, $3.00. The first number contains 16 pages and 54 references.

Such a periodical is very valuable and those connected with its production deserve high commendation and the thanks of all astronomers.

The number of periodicals from which abstracts are made is eight, all but one printed in English. If this number could be increased to include practically all the world's astronomical periodicals the *Digest* would be simply indispensable. It is refreshing to see a new astronomical journal spring up at this time of economic depression, and the present writer wishes it a long and useful life.

AUDIBILITY OF THE AURORA.

At a meeting of the Royal Society of Canada in May, 1932, a paper on the aurora by Dr. C. S. Beals, of the Dominion Astrophysical Observatory, Victoria, B.C., gave rise to a lively discussion on the question of its audibility. Among those tendering evidence was Dr. H. E. Bigelow, Dean of Applied Science, Mount Allison University, Sackville, N.B., and at the request of the present writer he has supplied the following statement:—

"The experience of which I spoke to you in May occurred about 1916 during a visit to my old home at Spencers Island, Cumberland County, N.S., on the shore of the Bay of Fundy. The time, if I remember correctly, although I cannot be sure of that, was in the fall. The aurora was exceedingly bright and at times quite distinctly coloured, and coincident with these unusually bright flashes I heard a very low sound something like that made when you sound S repeatedly. It occurred in intensity and decreased as these long streamers shot to the sky. As I have earlier said, I was under the impression, I don't know why, that these displays of aurora had often been heard before, and so I attached no great significance to the fact that I heard them myself. My home is within 100 yards of the shore, but I would rule out without any question the thought that it was any sound of the waves on the beach. From my bedroom for years I listened to sounds of that sort and they are entirely

unlike any such sound that I heard on the night in question. Moreover, they were always coincident with these long streamers and I am perfectly satisfied they were caused directly or indirectly by them."

The different parties coöperating in the Polar Year observations are giving special attention to this question and it is hoped that evidence obtained by them will lead to a solution of it.

The Leonids a Disappointment.

Again the Leonid meteors failed to give a demonstration in full strength, although a few were seen at some places where the sky was clear. In a letter to Mr. D. R. P. Coats, radio broadcaster for the "Winnipeg Free Press", Mrs. Georgina Gillanders, of Faulkner, Man., reports: "I thought it might interest you to know that while waiting for a train at 4.45 a.m. Wednesday (Nov. 16) at Faulkner Station, I saw four or five meteors flash across the sky very swiftly. . . . Those I chanced to see were overhead. I was looking towards the west. The one which showed for the longest time fell towards the north."

Scientific Apparatus for Sale.

Mr. A. F. Miller, one of the founders of the R.A.S.C., and until recently a very active member, is happily still living in Toronto and is in full possession of his accomplished mind, but his eyesight is greatly impaired. Some time ago he sold his 4-inch refractor and now he wishes to dispose of his other scientific apparatus, including the equipment he used for many years in spectroscopic and astrophysical investigations. It is offered much below cost. A list of the apparatus and all particulars may be obtained from Charles Potter, optician, 16 Adelaide St. W., Toronto.

C.A.C.

MEETINGS OF THE SOCIETY

AT WINNIPEG

March 9, 1932.—The regular monthly meeting was held at 8.15 p.m. In the unavoidable absence of the president, Dr. N. J. Maclean, the vice-president, Mr. A. W. Meggett, took the chair.

The speaker of the evening was the Right Rev. T. W. Morton. His subject was "Our Moving Observatory".

"The earth a moving observatory", is the title of one of the chapters in Norman Lockyer's "Lessons in Astronomy". The diurnal rotation and the annual revolution of the earth cause a constant shifting of the position of the stars in the sky, and make it difficult for beginners to identify the stars. Three systems of co-ordinates are used in Astronomy to define the position of the heavenly bodies. First: the vertical and horizontal measurements called altitude and azimuth. This is used by surveyors and navigators, and also by astronomers for local data of the sun. Second, angular or arc measurement from a point in the equator and from the equator towards the pole, called right ascension and declination. This is used almost exclusively for stars. Third. celestial longitude and latitude, measuring from a point in the ecliptic and the celestial pole. This is used for the planets and also for sun and moon. The zero point for right ascension and celestial longitude is the intersection of the equator and ecliptic, called the first point of Aries.

Time is a factor in astronomical measurement. There are four kinds of time. 1. Sidereal time, which is local for every observatory, is reckoned from successive transits of the first point of Aries,—in practice from transits of clock stars. 2. Apparent solar time, observed on the sun dial. This varies from day to day. December the 21st is the longest, and, as regards daylight, the shortest day of the year; September the 16th is the shortest. These variations make apparent time useless for measurement. 3. Mean solar time, measured from an imaginary sun moving with uniform velocity along the celestial equator instead of the ecliptic and completing the circle in one year. The difference between apparent and mean time is called the equation of time. 4. Standard zone time, which differs from Greenwich time by one hour for every 15° of longitude. This gives Winnipeg half an hour of daylight saving all the year round. Sidereal time gains on Greenwich mean time 10 seconds an hour, four minutes a day, half an hour a week, two hours a month, a day in the year.

The lecturer then showed and explained lantern slides of the chief constellations.

The beginner, without observatory or telescope, and dwelling in a city,

cannot see many of the constellations on account of the glare of city lights. It is most useful to him to remember the R.A. of the first magnitude stars, a line from Megrez where the handle joins the dipper, through the pole star, continued through Beta Cassiopeae and Alpha Andromedae, gives the zero line. From this the right ascension of the first magnitude stars can be estimated and the stars easily identified. At the opening of the World's Fair at Chicago next year the machinery will be started by light from the star Arcturus collected by a photo-electric cell."

S. C. NORRIS, *Secretary.*

AT TORONTO

May 10, 1932.—The last regular meeting of the 1931-32 season was held at 8 p.m. Mr. A. R. Hassard was in the chair. There was one election to Membership: Mr. A. W. Carrick, 87 Glen Road, Toronto.

The constellation study "Leo" was given by Mr. S. C. Brown.

Mr. J. R. Collins, Chairman of the Eclipse Committee, addressed the meeting on, "Proposed methods of observing the solar eclipse of August 31st". After a reference to the various types of eclipses, partial, annular, and total, there followed a description of the instruments necessary for photographic and visual observations. It was stated that several of the members would take telescopes and cameras, white sheets for the observation of the shadow bands, and other equipment. The lecturer referred to the Labrador expedition of 1905 (of which he was a member) as being completely equipped for every method of observation known at the time, and expressed the hope that some financial assistance might be obtained whereby the present expedition of the Society would be enabled to purchase additional equipment to that already possessed. A self-recording barometer and thermometer would be very useful. It was thought originally that the expedition would be divided into two parties, with duplicate equipment, to be stationed at widely separated points, but this was abandoned owing to lack of funds. The party had decided, therefore, to locate at Louiseville, P.Q., a short distance from the central line of totality. Invitations to join the expedition had been sent to the other centres of the Society and several had accepted.

October 18, 1932.—The first regular meeting of the autumn term was held at 8 p.m., Mr. R. A. Gray in the chair.

The evening was devoted to hearing reports by members of the General Society's observations of the eclipse of the sun at Louiseville, P.Q., and elsewhere. Mr. J. R. Collins, Chairman of the Eclipse Committee, described the grandeur of the spectacle and commented upon observations made by the members of the expedition. Several slides and photographs were shown of the corona, cloud effects, the advancing shadow as defined upon the clouds, and views of the activities of the members at the location. Mr. J. Whitehouse referred to the shadow bands as most elusive to photograph, although they were clearly observed. Their speed was estimated to be about seventy-

five miles per hour. Mr. H. W. Barker outlined his own observations and indulged in some humorous comment upon various incidents during the expedition. The artistic aspect of the total phase was the subject of the remarks by Mr. R. A. Gray. He exhibited a painting portraying his conception of the glory of the corona, and also paintings of the eclipsed sun and other phenomena at the time by Mr. S. J. Versteeg of London, Ont.

The Hamilton Centre was represented at the meeting by its honorary president, Dr. D. B. Marsh, the president, Mr. W. S. Mallory, and Mr. W. G. Milne. They described the observations of their Centre at Actonvale, P.Q. This expedition was quite successful. A splendid photograph of the corona of eight seconds' exposure was shown. The feature of the evening, moving pictures of the eclipse, was supplied by Mr. Milne, and drew much applause from the audience. Mr. Milne had ingeniously used in his camera the objective of a 2-inch telescope to provide a larger image, and the results obtained were very creditable. The total phase was clearly shown, exactly as it appeared to the naked eye. Mr. Milne is to be congratulated on his difficult achievement.

November 1, 1932.—A regular meeting was held at 8.00 p.m., Mr. R. A. Gray in the chair.

J. R. Collins, chairman of the committee on the recent solar eclipse, reported receipt of a letter from Mr. R. S. Lynd, president of the Amateur Astronomers' Association of New York City, thanking the Society for prints of photos taken at Louiseville, where a party from the New York organization was also stationed. Mr. Lynd in his letter also extended to the members of the Royal Astronomical Society of Canada an invitation to visit the Amateur Astronomers' Association headquarters and exhibits in the American Museum of Natural History, when in New York.

Nine persons were elected to membership in the Society: George A. Cline, M.A., Hart House, University of Toronto; J. C. Nutter, 112 Cluny Drive, Toronto; H. N. Cones, Bureau of Standards, Washington, D.C.; T. S. Bassett, 330 Baldwin Avenue, Charlotte, N.C.; Shigeso Hagashi, John Jay Hall, Columbia University, New York; L. N. Richard, 195 Patterson Avenue, Ottawa, Ont.; Miss Eloise Stafford, 73 Main Street, Morrisville, Vermont; J. S. Supernaw, M.D., 201 Virginia Terrace, Madison, Wisconsin; Rev. S. J. Taylor, 309 Paulson Avenue, Pittsburgh, Pa.

Several communications were read concerning recent meteor observations. Mr. F. Hooker reported by letter the observation of a brilliant meteor about 3.25 a.m. on September 18. Two letters transmitted to Dr. Chant, director of the meteor section, by Prof. Kingston of London, were read. Miss Julia Ford of St. Marys, Ont., with Mr. and Mrs. John Tanton, reported observation of nearly one hundred Perseids in two hours' watch on night of August 11-12. Mr. High Dowker, of Toronto, reported by letter the observation of 422 meteors, of which he listed 349 as Perseids, observing from 8.25 p.m. to 4.22 a.m., on the same dates.

Reference was made to the death on September 28 of the Rev. Dr. Robert Norwood of New York City, a well-known preacher and poet of Canadian birth, and a former member of the Society.

The guest speaker, Major E. H. Anundson of the London Centre, then addressed the audience on "The Mythology of the Stars", introducing the sky as "the world's first picture book". It is generally accepted that our star-lore had its beginnings in antediluvian times. Early man, who was primarily agricultural in his life, watched the rising and setting of the stars in order to foretell the arrival of the seasons or to determine the correct time for the planting and harvesting of his crops. This sky study developed into a star worship, probably the first form of religion, from which evolved the astrology which did so much to hinder the progress of real knowledge in the early days.

Because the stars in a large circular area surrounding the southern celestial pole do not figure in the star lore of the ancients, and did not appear on charts until comparatively recent time, we know that the designers of the constellation groups lived between the 36th and 42nd parallels of north latitude. The absence from the star groups of many animals, then and now common in India, Arabia and Egypt is good evidence that the originators of the "sky zoo" were not inhabitants of these lands, while the presence of Leo (the Lion) is sufficient proof that they were not from Greece, Italy or Spain. Again, the existence of such figures as Hydra (the Sea Serpent), Capricornus (the Sea Goat), and Cetus (the Whale), tells us that they were well acquainted with the sea. This leaves only Asia Minor and Armenia as the logical points of origin; and it is most probable that the constellation forms actually had their beginnings amongst the Akkadians, predecessors of the Babylonians in the Euphrates valley, about 2800 or 3000 B.C.

The mythology connected with the figures appears to have originated with the Greeks at a later date, and there are nearly as many legends connected with some of the constellations as there are naked eye stars in that group. Many of these legends were retold with the aid of lantern slides. Of particular interest was one theory concerning the origin of the name Great Bear for a star group which in no way bears a resemblance to that animal. The Sanskrit words for "bear" and "bright stars" were identical, and a confusion between these words in early time may account for the name by which Ursa Major has since been known. The Pleiades, famous in poetry, seem also to be stars of ill-omen, for among all the ancient races there was a dread mystery concealed in them, and many religious festivals, (including All Hallows' Eve and All Souls' Day in England, the Hindu Feast of Lamps and Japanese Festival of Lanterns, and similar memorial services to the dead in Egypt, Peru and with almost every other race,) appear to be connected with the midnight culmination of the Pleiades, which occurs about November 1. In conclusion, Major Anundson pointed out that

"astronomy is, more or less, a golden thread, running through all history, binding together all tribes and peoples, regardless of their present place of abode".

FREDERIC L. TROYER,
Acting-Recorder.

AT LONDON

October 14, 1932.—A regular meeting was held at 8 p.m., in the London Life Building. There were 67 people present.

President McKone introduced the speaker for the evening, Major E. H. Anundson, who addressed the members on the subject "The Mythology of the Stars". The origin and general history of the constellations was first discussed. Astronomy unites with history in pointing to the Euphrates Valley and the region of Mount Ararat as the home of those who originated the ancient constellation figures. Authorities agree that the originators of stellar lore were not the Semitic Babylonians, but a people called Akkadians —an ancient race who came down from the mountainous region east of Syria, bringing with them the rudiments of writing and civilization. The Babylonian Tablets reveal that the Akkadians introduced their zodiac into Babylonia before the year 3000 B.C., and the zodiac of the Akkadians corresponds almost exactly with the signs we know to-day. A close inspection of the stellar groups gives everywhere the indication of design, not chance, in their arrangement. Throughout the centuries there was some endeavour to change the nomenclature of the star groups. The twelve Apostles have been each represented by a constellation, and other Biblical names have been substituted for time-honoured figures. These substitutions were not popular and have failed of general acceptance.

It is to Greece that the present world is indebted for the many interesting myths associated with the constellations. The famous Grecian legend of Perseus and Andromeda links up the constellations Andromeda (the Chained Lady), Perseus (the Champion), Pegasus (the Flying Horse), Cassiopeia (the Lady in the Chair) and Cepheus (the King). The story of Perseus was well-known in Greece before the fifth century B.C., since both Euripides and Shophocles wrote a drama based on the story of Andromeda. It is uncertain whether the legend itself suggested the constellations involved, or vice-versa. These five constellations were illustrated by lantern-slides.

To represent the constellation Aquarius (the Water Bearer), the astronomers of all nations, with the exception of the Arabs, have adopted the figure of a man pouring water from a jar. The Arabs, forbidden by law to draw the human figure, have represented this constellation by a mule, saddled and carrying two buckets of water on its back. The various myths associated with the constellation were related. Closely identified with Aquarius is Piscis Australis (the Southern Fish); this figure generally appears in an upright position, mouth agape, drinking in the stream that

flows down the sky from the water jar of Aquarius. The most brilliant of all constellations, Orion (the Great Hunter), was discussed next, with the various legends attached thereto. Next came the mythological histories of Canis Major (the Greater Dog) and the constellation Gemini (the Twins). Ursa Major is the most easily recognized and the most ancient of the star groups; it is universally known as the Great Bear. The arrangement of the stars in this group in no way suggests a bear. A discussion of the Pleiades came next, the speaker referring to the fact that from time immemorial this group has impressed mankind with a sense of mystery; a great cataclysm is in some way connected with them. Memorial services to the dead at the season of the year when the Pleiades occupy a conspicuous part in the heavens are known to have taken place in the history of almost every nation from remote antiquity to the present day. The myths in connection with the so-called lost Pleiad concluded the lecture. All the constellations under discussion were illustrated by lantern slides. The thanks of the London Centre were extended by President McKone to the speaker.

Mr. F. H. Coates then presented a report on the variations in the intensity of the sun's light during the recent solar eclipse. This report is embodied in a graph, taken by a self-recording photometer, which the eclipse expedition of the London Centre set up at Louiseville, P.Q. Several interesting pictures taken by Mr. Coates during totality were exhibited, in particular one picture of Bailey's Beads. Mr. S. J. Versteeg, the artist of the London Centre, displayed some remarkable paintings of the corona, prominences, and the shadow bands during the total eclipse; the pictures were painted from memory and the members were deeply impressed with the accurate interpretation of what the artist had observed. A few of the pictures taken by Mr. and Mrs. McKone on their tour of the various eclipse expeditions in the path of totality were exhibited. The meeting then adjourned.

G. R. MAGEE,
Secretary-Treasurer.

AT VANCOUVER

August 17, 1932.—The Vancouver Centre of the Royal Astronomical Society was extremely fortunate in being able to sponsor an illustrated lecture by Sir Frank Dyson, K.B.E., LL.D., F.R.S., Astronomer Royal of England, who was on his way east to take part in observing the eclipse and in the meeting of the International Astronomical Union.

Sir Frank was introduced by Dr. Shrum, and took as his subject "The Contribution of the Royal Observatory to Navigation and Astronomy".

The Greenwich Observatory has been under the direction of many distinguished astronomers. Founded in 1675 by Charles II, primarily for work on the determination of longitude for the assistance of navigation, the observatory had for its architect the famous Christopher Wren. Flamsteed was the first astronomer in charge, and was succeeded by Halley, who is famous for his magnetic chart and for his work on the comet named after

him. Bradley, who became Astronomer Royal in 1742, was responsible for the discovery of the aberration of light and the first clear proof that the earth travels around the sun. Maskelyne published a Nautical Almanac and was the first person to weigh the earth.

About this time the Government offered a prize of £20,000 for an instrument which would determine longitude. This prize was won by Harrison and a copy of his chronometer was used by Captain Cook and later by Captain Vancouver. Pond was responsible for improvements to instruments and the introduction of the time-ball. Sir George Airy became astronomer in 1831 and made use of a new transit circle, which since that time has been used in some 600,000 observations and is still in use. Sir George also constructed a 13-inch telescope and introduced time signals. At present the time from Greenwich clock is broadcast every fifteen minutes. Sir Wm. Christie, who took office in 1851, introduced the use of photography in astronomical work. He studied the rotation of the sun as followed by observations of the sun-spots. The lecturer here stated that he is convinced that sun-spots have nothing to do with the weather, but do affect the northern lights. Christie built a 28-inch telescope for the purpose of photographing the entire sky and carried on observations on double stars and the measurement of star distances and temperatures. Recent work has been connected with measurements of correct time.

The lecture was illustrated by slides showing some of the early apparatus and portraits of the astronomers, and concluded with the showing of some pictures of the Observatory as it is to-day.

In moving a vote of thanks to the speaker, Mr. Forsyth expressed the appreciation of the audience for a most interesting insight into the history of a world famous institution, and for the honour of this visit from the Astronomer Royal. The motion was seconded by Mr. Gill.

(A short illustrated history of the Royal Observatory is published and copies no doubt will be sent on application to the Astronomer Royal, Greenwich, London, S.E. 10.)

September 6, 1932.—The eighth regular meeting took the form of an outdoor meeting and was held at the University of British Columbia, about fifty members attending.

Telescopes were provided by various members, Mr. Teasdale exhibiting his six-inch reflector, Mr. McGrath a three-inch refractor, and several smaller instruments also being used. Excellent views were obtained of Saturn and the moon, which was at the half.

The meeting then convened in the Science Building, where Dr. Buchanan gave an interesting talk on the moon and solar system, illustrating with slides.

After the meeting, further observations of the sky were made, notably of the double star, Mizar, the cluster in Andromeda and nebulae in Andromeda and Lyra.

WILLIAM URE,
Recorder.

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